ELECTROENCEPHALOGRAPHIC STUDY
OF HELEN KELLER

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Archives of Neurology and Psychiatry, v. 57, No. 5 May, 1947
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AN ELECTROENCEPHALOGRAPHIC STUDY OF HELEN KELLER

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ALMOST every one is familiar with the case of Helen Keller and her remarkable mastery of the handicap she suffered so early in life. Hers was a normal life until the age of 19 months, when she had a severe illness, of sudden onset and short duration, which left her totally blind and deaf.

Berger [1] and Loomis, Harvey and Hobart [2] reported the presence of alpha rhythm in blind persons. Gibbs and Gibbs [3] reviewed the literature and studied the effects of auditory, visual and tactile stimuli on the occurrence and amplitude of alpha waves. Visual and auditory stimuli are automatically ruled out in the case of Helen Keller because of her total blindness and deafness, and tactile stimuli, to have any effect on the alpha waves, must attract the subject's attention. Hence, tactile stimulation was the only external stimulation it was necessary to control in this study.

Adrian and Matthews [4] and Jasper and Andrews [5] showed that the occipital areas in children and in adults usually have more alpha activity, and the frontal and parietal areas more 15 to 30 cycles per second activity, than any other area.

According to Gibbs and Gibbs,[6] there are relatively few cases in which the alpha activity, although present in all leads, has a higher amplitude in the frontal and motor (parietal) leads.

These facts are significant in a critical analysis of the electroencephalogram of Helen Keller, who was 64 years of age at the time of this examination.

From the Department of Electroencephalography, LaGarde General Hospital.

1. Berger, H.: Ueber das Elektrenkephalogramm des Menschen, Arch. f. Psychiat. **103**:444-454, 1935.

2. Loomis, A. L.; Harvey, E. N., and Hobart, G.: Brain Potentials During Hypnosis, Science **83**:239-241 (March 6) 1936.

3. Gibbs, F. A., and Gibbs, E. L.: Atlas of Electroencephalography, Cambridge, Mass., Lew A. Cummings Company, 1941, p. 46.

4. Adrian, E. D., and Matthews, B. H. C.: The Berger Rhythm: Potential Changes from the Occipital Lobes in Man, Brain **57**:355-385 (Dec.) 1934.

5. Jasper, H. H., and Andrews, H. L.: Electroencephalography: III. Normal Differentiation of Occipital and Precentral Regions in Man, Arch. Neurol. & Psychiat. **39**:96-115 (Jan.) 1938.

6. Gibbs and Gibbs,[3] pp. 42-44.

METHOD

The electrical activity from four cortical areas was recorded simultaneously with a four channel Grass electroencephalograph. Monopolar leads were used for routine examination, according to Gibbs's standard technic.[7]

Recording was done under standard conditions, namely, in a darkened and electrically shielded room, which was air conditioned. (Warmer climates necessitate air conditioning as an integral part of laboratory facilities if reliable results are to be obtained.) For the patient's comfort, an examining table with an air mattress was substituted for the usual easy chair. In prolonged examinations, the examining table or bed is much preferred, since fatigue is minimized and artefacts due to muscular tension and movement are substantially reduced.

Analysis of this record is primarily in terms of variation in amplitude and of the alpha index. The alpha index is the percentage, that is, the number of centimeters, of alpha activity (at least three consecutive waves of 8.5 to 12.0 cycles

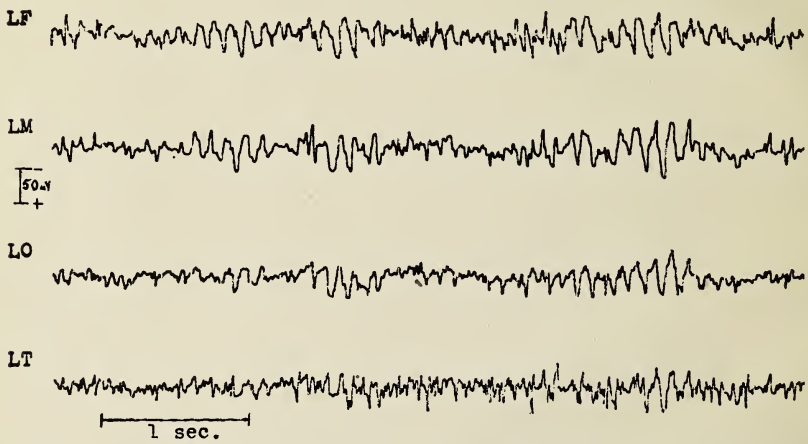

Fig. 1.—Increased amplitude of alpha waves in frontal and motor leads during the resting stage.

per second) in a continuous sample of record 1 meter in length. Alpha indexes were computed for the resting phase of the electroencephalogram and for varying intervals after three minutes of hyperventilation. Amplitude averages for the frontal, motor and occipital areas were computed by measuring each of a representative series of the alpha waves found in the resting stage and in the post-hyperventilation stages. The samples used for measurement of amplitude were the same as those used in determining the alpha indexes.

Since all patients do not cooperate to the same degree in hyperventilation, it has been found desirable in certain instances to allow a longer period for hyperventilation than that adopted by Gibbs and associates.[8]

7. Gibbs and Gibbs,[3] p. 22.

8. Gibbs, F. A.; Gibbs, E. L., and Lennox, W. G.: Electroencephalographic Response to Overventilation and Its Relation to Age, J. Pediat. **23**:497-505 (Nov.) 1943.

OBSERVATIONS AND RESULTS

In the resting stage, all leads showed moderate low voltage fast (18 to 24 cycles per second) activity interspersed with brief runs of poorly organized 9 to 12 per second waves. The temporal leads showed much fast (18 to 30 cycles per second) activity, which was an artefact due to undiminished muscular tension.

Short runs of alpha activity occurred more frequently and were better organized in the frontal and motor areas than in the occipital area during

Average Amplitudes for Alpha Waves

Cortical Area	Average Amplitude, Microvolts			
	Resting Stage	After Hyperventilation		
		20 Sec.	86.3 Sec.	230 Sec.
Left frontal	46.42	Not available after hyperventilation		
Left motor	45.24	50.00	41.64	43.43
Left occipital	28.24	38.57	37.52	37.36

the resting stage of the record. Also, the alpha potentials recorded from the frontal and motor areas showed a maximum amplitude of 75 microvolts, as compared with the maximum of only 50 microvolts for the potentials from the occipital area. This is just the reverse of the usual finding, for it is the occipital areas which ordinarily show the dominant

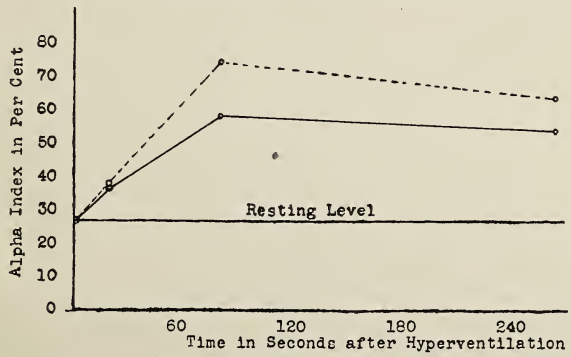

Fig. 2.—Graphic representation of sustained increase in the alpha index after hyperventilation. The solid line indicates the values for the motor lead; the broken line, values for the occipital lead.

activity. This diminished amplitude from the occipital area was constant throughout the record, as can be seen in the table.

Brief localization studies (bipolar recording) on a push-pull circuit were made but revealed no evidence of a focal lesion. After this, monopolar recording was resumed for the hyperventilation run. After three minutes of hyperventilation, no immediate build-up occurred and no seizure discharges were precipitated.

The alpha index for the resting stage of the record was 28.2 per cent. Hyperventilation tended to stabilize the record and increased the alpha activity, particularly in the occipital areas. Twenty seconds after hyperventilation the alpha index rose to 36.0 per cent in the motor lead and 36.95 per cent for the occipital lead. The alpha index reached its peak approximately 86.3 seconds after hyperventilation was concluded, at which time the alpha index was 57.3 per cent for the motor lead and 73.6 per cent for the occipital lead. Four and one-half minutes (two hundred and seventy seconds) after hyperventilation was concluded, the alpha index had decreased to 51.8 per cent for the motor lead and 61.75 per cent for the occipital lead.

SUMMARY

In the resting stage, the electroencephalogram of Helen Keller showed better organized alpha activity in the frontal and motor leads. Consistently, throughout the record, the frontal, and especially the motor, leads showed an amplitude greater than that observed in the occipital leads. Hyperventilation, which increased the alpha activity in the occipital leads, did not increase the amplitude of the potentials from the occipital areas to such an extent that they equaled in amplitude the potentials recorded from the motor areas.

Since all of Helen Keller's learning and experience is through her sense of touch or tactile discrimination, with particular emphasis on the corresponding cortical areas, it is suggested that the amplitudinal differences recorded in the electroencephalogram may be correlated with differences in the functional organization of the cerebral cortex.

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